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DISCUSSION OF PROCEEDINGS - SEPARATES

503, 611, 612

WATERWAYS DIVISION

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Discussion of
"DEVELOPMENT OF THE DELAWARE RIVER FOR COMMERCE"

by B. B. Talley
(Proc. Sep. 503)

CHARLES L. HALL, M. ASCE.[1]—Colonel Talley presents an interesting discussion of a greatly expanded project for the Upper Delaware. Anyone who has seen the work which the United States Steel Corporation has done just below Morrisville can have no doubt as to the scale and character of the prospective commerce on the river. But one question which once worried the writer is not answered in this paper.

The project depth between Philadelphia Navy Yard and deep water has been 40 feet at low water for a long time. A great deal of money has been expended on dredging, and certainly the material involved is soft enough. But has there ever been at any single moment a depth of 40 feet at mean low tide over the entire stretch from Philadelphia to New Castle? And if this depth has not been provided, with all the money spent there on dredging and regulating works, what is the use of obtaining a 40 foot channel above Philadelphia? This is the sort of question which does not worry the commercial sponsors of the improvement very much, but should worry the responsible engineers. It is to be hoped that the author's closure will cover this matter.

1. Washington, D. C.

Discussion of
"GRAPHIC DESIGN OF ALLUVIAL CHANNELS"

by Ning Chien
(Proc. Sep. 611)

T. BLENCH,[1] M. ASCE.—The design diagrams, Figs. 1 - 3, represent a remarkably bold extrapolation. The data on which they are based are from laboratory flume experiments with trifling discharges, unnatural uniform sediments, and slopes very poorly measureable. The proposed field of application is enormous; for example, a channel of 50 cfs/ft discharge intensity, with average loam sides, and bed material 0.25 mm in negligibly small quantities, would have a natural width of about 250 feet and take 12,500 cfs. It would also have about 13.6 feet of depth, but Fig. 1 prophesies that it would have 20 feet. If the data on which the diagrams are based were plotted, they would fall either outside or in a small zone in the left-hand corner. Moreover, they would not be the original data, but the results of "removing the effect of the sides" by making the incorrect assumption that velocity is uniform over a section and then performing a separation based on the further assumption that Manning's equation applies to the rather peculiar parts into which the section is divided (see Separate No. 565).

Although there is no direct means of checking, in the field, the reliability of the load curves—since bed-load cannot be measured in the field—the formulas of regime theory,(G-I) which fit the dimensions to which channels actually adjust in the field, can be applied to verify whether the diagrams are functionally correct along loci of equal ratio of load to discharge. The writer gives details of such a check in his discussion on Separate No. 565 (which merits reading along with the present Separate), and is satisfied that the diagrams are functionally incorrect. Further, from examples such as quoted above of the diagrams giving 20 feet deep for nature's approximate 13.6, he is satisfied that they are factually too incorrect to be recommended for practical use.

The writer feels that the references to LACEY and LEOPOLD and MADDOCK are misleading, so attempts to put matters in a wider perspective. Gerald Lacey laid the quantitative basis of modern regime theory in the 1920's when he was placed on special duty by the Govt. of the United Provinces of India for that purpose. Its importance to the engineer is that, whatever views may be held about the theoretical side, the three fundamental formulae resulted from observing how canals actually adjust in the field, so permit nature to be copied. Lacey's initial work is readily available in papers dated 1929 and 1933.(A, B) His formulas were recommended for use in 1933 by the Central Board of Irrigation of the Govt. of India.(C) Nobody has successfully assailed the functional correctness of the Lacey equations, but they did have a defect that might be stated, nontechnically, as "averaging the relative importance of bed and sides." This defect arose from the nature of the data available and affected only the coefficients in his formulas. Practical engineers dealt with

1. Prof. of Civ. Eng., Univ. of Alberta, Edmonton, Canada, and Cons. Engr.

this secondary difficulty by various means, including using the formulas in a definite sequence. The situation was stated neatly by Sir Claude Inglis to the effect that all Lacey channels were regime channels, but not all regime channels were Lacey channels. During the 1930's the Irrigation Research Institutes of India, and various individual engineers, made exhaustive field studies aimed at resolving the difficulty. Using the information they gathered, Mr. Cuthbert King of the Punjab Irrigation Service, and the writer, were able to suggest how to account for bed and sides separately. Their findings were published in 1941 and 1943;(D, E) this publication is confirmed in a later and more readily available one.(F) These findings affected all three Lacey formulas; the formula (I) quoted in the present paper was replaced by

$$b = (F_b Q/F_s)^{0.5} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where F_b and F_s depend on the nature of the bed and of the sides respectively. The War interrupted further work and publications. After the War the writer found himself the only person left with the opportunity to try to spread the valuable information obtained in Pakistan and India, so has been attempting to do so,(G-M) and to continue to extend the results to rivers. The work of LEOPOLD and MADDOCK is, so far as the writer knows, the first comprehensive scientific attempt to analyse actual river data, and merits the closest study. These authors have used their personal methods of analysis; but the writer likes to think of their work as doing for rivers what Lacey did for canals. They agree exactly with the functional correctness of equation (1), with discharge taken as long-period arithmetic mean. The author has, unfortunately, referred to page 9 of their work,(8) which, as he correctly states, refers to "variation in a particular cross-section of a river;" but that is irrelevant to the context. Their page 16 refers to "variation downstream" and gives the Lacey value of 0.5 instead of the erroneously quoted 0.26.

The author's information on the Atchafalaya channel is interesting. In the reference he quotes(13) the present writer has also shown how simply regime formulas can be applied to explain occurrences.

Recently some investigations have been made into small flume data using regime theory methods. (L, N) The raw data are readily amenable to this treatment. The writer's opinion is that the data require tremendous amplification by improved methods before there can be the least justification for extrapolation into the field of practice.

It is difficult to understand why the author expressed some doubts about the application of his laboratory flume data to canals, while being confident of their applications to rivers that obey the same laws but are complicated by variations of discharge and by meandering; meandering can alter slope by at least 100%.

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L. "Bed-Load Transportation Formulas for Uniform Sediment in Uniform Flumes with Smooth Sides." Submitted to IAHR for 1955.

M. "Practical Regime Theory Design of Artificial Channels with Self-Adjustable Boundaries." T. Blench. Submitted, on request, for ASCE St. Louis Conference, June 1955.

N. Thesis on Analysis of Bed-Load Data by R. B. Erb, submitted as part requirement for degree of M. Sc. from University of Alberta. 1955.

Discussion of
"RIVER SURVEYS IN UNMAPPED TERRITORY"

by Gerard H. Matthes
(Proc. Sep. 612)

F. T. MAVIS,[1] M. ASCE.—The author has woven into this brief paper the romance of exploring geographical frontiers with the reality of present day reconnaissance by engineers who must travel light. In a literature that is mounting with refinements in methods, instruments and techniques, it is stimulating to read a paper which subtly nudges the civil engineer to train his eyes to see, his mind to reason and consider, and his whole being to be resourceful and alert.

The writer would underline these excerpts in a different order and possibly with a different meaning from what may have been intended: ". . . today the limitations confronting the engineer called upon to report on foreign project possibilities are more severe owing to differences in languages, local customs and modes of travel. In exploratory work the mode of travel usually determines the type of instrumental equipment. . . . [Some instruments are] too delicate for rough travel as on horse or camel back. A first reconnaissance by airplane or hydroplane is always helpful toward gaining a comprehensive view of the river, its valley and tributary characteristics, and the extent of settlements, roads or trails. . . . The need of an interpreter in the party is essential. . . . Since no two rivers are alike nothing should be taken for granted and frequent inquiries are necessary. Native boatmen have a fund of information relating to low-water depth on shoals, the kind of craft used for transporting freight [among other things] . . . ." The foregoing quotation would hardly be out of context either in exploring an uncharted reach of river (as in the author's paper), or in exploring mathematical wildernesses or the applications of nuclear science to engineering practice. However, in scientific exploration it is not always easy to distinguish between "native boatmen" and opportunists who have yet to make their first trip once.

The progressive civil engineer must use many devices to get information he needs to solve his problem. He may make "a first reconnaissance by airplane" or a flight of fancy—he may follow a hunch; he may experience "rough travel as on horse or camel back" through fields of mathematics or science that are by him unexplored (and that can be rough too!).

". . . . In open valleys horseback travel is to be recommended. . . . A horse does a better job than a man. . . ." These fragments admittedly out of context, commend the virtues of good horse sense!

The reader would do well to look behind the printed word (which in itself is good) and to build up his own allegory. He can find in the paper stimulation—whether his aim be to make river surveys in unmapped territory or to explore the unknown in the unmapped territory of science and the arts of civil engineering.

1. Prof. and Head, Dept. of Civ. Eng., Carnegie Inst. of Technology, Pittsburgh, Pa.

A sage among civil engineers, the author has modestly woven experience, fact and folklore into a paper whose impact on his readers may be far greater than he had expected. He might have prefaced it with the quotation from Thomas Campbell:

> "Tis the sunset of life gives me mystical lore
> And coming events cast their shadows before."

PROCEEDINGS-SEPARATES

The technical papers published in the past year are presented below. Technical-division sponsorship is indicated by an abbreviation at the end of each Separate Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. For titles and order coupons, refer to the appropriate issue of "Civil Engineering" or write for a cumulative price list.

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c. Discussion of several papers, grouped by Divisions.

e. Presented at the Atlantic City (N.J.) Convention in June, 1954.

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